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**PRODUCT IMPROVEMENT PROGRAM
TO INCREASE THE NERVE AGENT
SENSITIVITY OF THE M256 CHEMICAL
AGENT DETECTOR KIT**

by Robert Eckhaus
DETECTION DIRECTORATE

June 1987



Aberdeen Proving Ground, Maryland 21010-5423

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PREFACE

The work described in this report was authorized under Product Improvement Program Number DA-1-81-08-3021. This work was started in May 1981 and completed in June 1984.

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PRODUCT IMPROVEMENT PROGRAM TO INCREASE THE NERVE AGENT SENSITIVITY
OF THE M256 CHEMICAL AGENT DETECTOR KIT

1. INTRODUCTION

In 1973, the Department of the Army established the requirement for the M256 Chemical Agent Detector Kit [Material Need (Engineering Development) for a Chemical Agent Detector Kit].¹ The M256 kit was adopted into the U.S. Army inventory in 1977 and was approved for full release to the field in 1978. The kit contains 12 sampler-detectors used to detect and classify chemical agents that are present in the air. Each sampler-detector responds to the following agent concentration levels:

Agent	Detectable Concentration (mg/cu m)
Nerve - GB	0.05
VX	0.10
Mustard	2.5
Phosgene oxime	5.0
Hydrogen cyanide	9.0
Cyanogen chloride	10.0
Lewisite	12.0

These detection levels were established to allow the soldier to safely unmask after a chemical attack. New requirements, however, have been established to detect nerve agents at the levels where miosis, the first sign of nerve agent poisoning, occurs. These levels are between 0.005 mg/cu m and 0.001 mg/cu m for both GB and VX.

The current M256 kit uses horse serum cholinesterase (horse enzyme) for the nerve agent test. Due to limitations in sensitivity of the horse enzymes, the M256 kit cannot detect the new lower levels required. A recent study showed that electric eel acetylcholinesterase (eel enzyme) is 10 times as sensitive to both GB and VX as the horse enzyme.² This work proved that the increased sensitivity levels could be met with the eel enzyme. This product improvement program (PIP) was established to prove that this capability could be added to the M256 kit and meet all the requirements of the kit.

2. NERVE AGENT DETECTION USING THE M256 KIT

The portion of the M256 sampler-detector used for nerve agent detection consists of a filter paper disc impregnated with horse enzyme (enzyme disc) and two glass ampoules, one containing a buffer solution (buffer solution ampoule) and the other containing a solution of 2, 6 dichloroindophenylacetate in ligroin (substrate solution ampoule) (See Table A-1). To conduct the test, the ampoule of buffer solution is broken to wet the enzyme disc. The sampler-detector is then exposed to the atmosphere. After 10 minutes, the ampoule of substrate solution is broken and added. If nerve agent is present, the enzyme is inhibited so no reaction occurs, and the enzyme disc will remain white (or peach color due to the

natural color of the substrate solution). If no agent is present, the enzyme promotes the hydrolysis of the substrate, and the enzyme disc turns blue.

The improved M256 sampler-detector (M256E1) is operated in the same manner as the M256 kit. The only difference is that the enzyme disc is an ion exchange paper impregnated with an eel enzyme solution and the ampoule of substrate solution contains indoxyl acetate, which is a clear solution (see Table A-1). Except that the lower levels of agent can be detected with the improved enzyme disc, it responds in the same way as the original. No color indicates agent is present, and a blue-green color indicates that no agent is present.

3. TEST PROGRAM

3.1 Purpose.

The purpose of this test was to:

- Prove that the M256E1 will provide the increased sensitivity to nerve agent needed in the M256 kit.
- Ensure that the M256E1 meets all the requirements of the Material Need (Engineering Development) for the M256 kit.
- Determine if there is a difference in performance of the nerve test due to either the source of eel enzyme or the manufacturer of the sampler-detector.

3.2 Test Plan.

The M256E1 sampler-detectors were subjected to:

- Accelerated Aging Test to verify that the kit has a 5-year shelf life and to determine how to simulate the shelf life using an accelerated storage test.
- Sensitivity Test to verify that the enzyme disc will respond properly to 0.005 mg/cu m of GB and VX when tested in each climate type listed in Table A-2.
- Blank Response Test to verify that the enzyme disc will respond properly when functioned in the absence of agent in each climate type listed in Table A-2.
- Cyclic Storage Test to verify that the enzyme disc will respond properly when functioned in the absence of agent at 33 °F after being subjected to the cyclic storage tests shown in Table A-3.
- Interference Test to determine if the enzyme disc will respond properly when functioned in the absence of agent, but in the presence of the field interferences listed in Table A-4.

3.3 Test Criteria.

3.3.1 Eel Enzyme Content.

The amount of eel enzyme on the disc is critical. If too little enzyme is present, insufficient color will develop in the absence of agent and create a false positive test. If too much enzyme is present, there will not be enough agent at the concentration levels of interest to inhibit all the enzyme, and color will appear, producing a false negative test. Since the eel enzyme degrades with time, it is more likely for a fresh enzyme disc to give a false negative response and an aged enzyme disc to give a false positive test. Therefore, agent tests were conducted with fresh sampler-detectors (maximum enzyme concentration), and blank and interference tests were conducted with aged sampler-detectors (minimum enzyme concentration). The sampler-detectors were aged according to the results of the accelerated storage tests to simulate a 5-year shelf life.

3.3.2 Reliability.

The M256E1 kit must demonstrate a reliability of 92.5% with 90% confidence levels for each test. Each sampler-detector was operated according to the procedures described in the Operator's Manual³ except that only the nerve test was functioned. In addition, the color development time (response time) was increased from 2 to 3 minutes for temperatures above 50 °F (10 °C), due to the inherently slower rate of chemical reaction of the revised reagents on the improved disc. The reliability requirement was met when the number of failures observed during a test was less than or equal to the "Accept" criteria listed for the corresponding sample size, as shown in Table A-5.⁴

3.4 Schedule.

The test program was conducted in three separate verification tests:

- PIP Verification Test I was conducted from March to December 1982.
- PIP Verification Test II was divided into two phases; Phase I took place from March to May 1983 and Phase II from October to December 1983.
- PIP Verification Test III was performed from April to June 1984.

3.5 PIP Verification Test I (PVT I).

3.5.1 Selection of Manufacturers.

The two contractors who were producing the M256 kit, Chemical Compounding Corporation (CCC) and Bendix Corporation, were selected to produce the M256E1 sampler-detectors. Since each manufacturer was required to use eel enzyme from two suppliers (Sigma Chemical Company and Worthington Biochemical Company), four types of sampler-detectors were tested:

- Bendix/Sigma - Bendix-manufactured using Sigma eel enzyme
- Bendix/Worthington - Bendix-manufactured using Worthington eel enzyme
- CCC/Sigma - CCC-manufactured using Sigma eel enzyme
- CCC/Worthington - CCC-manufactured using Worthington eel enzyme.

In addition, the sampler-detectors manufactured for this test contained an ampoule of wetting solution (0.51 ml of 0.03% Triton X-100 surfactant in water) as a replacement for the ampoule of buffer solution. Since the eel enzyme disc already contained the necessary buffers, the development effort showed that only a wetting solution was needed for the nerve agent test.²

3.5.2 Results of PVT I.

3.5.2.1 Accelerated Aging Test.

The results of the accelerated aging tests showed that the enzyme disc from each type of sampler-detector has a shelf life of at least 5 years.⁴ To simulate a 5-year shelf life, it was necessary to age the Bendix sampler-detectors for 24 hours at 194 °F (90 °C) and to age the CCC sampler-detectors for 35 minutes at 90 °C.* The results of the enzyme assay (Table A-6) showed that the fresh Bendix enzyme discs contained 1.3 units of enzyme, and aged discs contained 0.8 to 0.9 units of enzyme. The fresh CCC enzyme discs contained 1.1 to 1.8 units of enzyme, and the aged discs contained 1.0 to 1.1 units of enzyme.

3.5.2.2 Agent Sensitivity Tests.

The results of the GB and VX tests conducted with the fresh sampler-detectors are shown in Tables A-7 and A-8, respectively. In both sets of tests, the agent concentration level was approximately 0.005 mg/cu m. Only a few isolated false-negative responses occurred. None of the incorrect responses could be attributed to the simulated climatic conditions in which the sampler-detectors were exposed and operated. Despite the few incorrect responses, each type met the accept criteria of Table A-5 for all climatic conditions and, therefore, exhibited a reliability at or above the required 92.5%.

3.5.2.3 Blank Response Tests.

The results of tests conducted on the aged sampler-detectors in the absence of agent are shown in Table A-9. Except for those exposed and operated at +33 °F (0.6 °C), the sampler-detectors met the reliability requirements for each climate type. The time for color development was in

* These aging conditions were based on preliminary results. By the time PVT I was completed, the accelerated aging test was concluded. The results showed that it was necessary to age all types of sampler-detectors for 24 hours at 90 °C to simulate a 5-year shelf life.

excess of the 5 minutes allowed by the operating instructions for each of the four types of M256E1 sampler-detectors. Those sampler-detectors that were exposed at +33 °F (0.6 °C), but warmed to 50 °F while waiting for color development, gave the proper negative responses. Since operating procedures direct the user to warm the sampler-detector before the substrate solution ampoule is broken when used at temperatures below +32 °F (0 °C), the false-positive problems that occurred at the aqueous limit (33 °F) did not occur during the Basic Cold Test (-33 °F).

3.5.2.4 Cyclic Storage Tests.

Following the 9-week storage period (Table A-3), the test items were functioned as blanks. Half of the sampler-detectors were operated at 33 °F and the remaining half at ambient (70 °F) temperatures (Table A-10). The items that were functioned at + 33 °F (0.6 °C) produced false-positive responses. Those functioned at ambient temperature performed satisfactorily except for the CCC/Sigma sampler-detectors. There is no apparent explanation for the poor performance of these items after cyclic storage.

The wetting solution ampoules of several sampler-detectors were found cracked after hot-cold cyclic storage. Due to the loss of the wetting solution, those sampler-detectors were unsuitable for use. Cracked ampoules of wetting solution were also found during sensitivity and blank tests when sampler-detectors were conditioned at -33 °F (-25 °C) prior to functioning.

3.5.2.5 Interference Tests.

The results of the blank tests conducted on the aged sampler-detectors in the presence of the interferences are shown in Table A-11. Burning brush, HC smoke, and pesticide vapors interfered with some of the Bendix sampler-detectors, causing false positive responses. The aged CCC sampler detector contained higher levels of enzyme than the Bendix sampler-detectors (see Table A-6), which accounted for the better results with the CCC items. The worst results were found in the presence of pesticide (Sevin); this was expected to some degree because Sevin is used as a simulant for the nerve agent test.

3.5.3 Conclusions from PVT I.

- The nerve agent testing portion of the M256E1 has a 5-year shelf life that can be simulated by aging the sampler-detector for 24 hours at 194 °F (90 °C).
- The M256E1 sampler-detector as manufactured by Bendix and CCC using either the Worthington or Sigma eel enzyme adequately provides positive responses to VX and GB at concentrations of 0.005 mg/cu m when the enzyme disc contains up to 1.8 units of eel enzyme.
- The M256E1 sampler-detectors will give false positive responses when operated in the absence of agent at temperatures at 33 °F when the enzyme disc contains less than 1.6 units of eel enzyme. However, if they are exposed at temperatures below 33 °F and warmed to temperatures above 50 °F, they will respond properly.

- The M256E1 sampler-detector will give false positive responses when operated in the presence of burning brush, HC smoke, and pesticide (Sevin) vapors when the eel enzyme disc contains less than 1.6 units of eel enzyme.

- The M256E1 sampler-detector will function properly in the presence of exhaust fumes, fuel vapors, and decontaminants when the enzyme disc contains more than 0.8 units of eel enzyme.

- The wetting solution ampoule will crack when subjected to temperatures of -30 °F.

- There is no significant difference in the performance of the sampler-detector due either to using a different manufacturer of the sampler-detector or source of eel enzyme.

3.6 PIP Verification Test II (PVT II).

3.6.1 Discussion.

In order to resolve the problems found in PVT I, the following potential solutions were investigated:

- Replace the wetting solution ampoule with the buffer solution ampoule used in the standard M256 kit.

- Increase the amount of eel enzyme on the enzyme disc to eliminate false positive results from interferences and low temperatures.

The buffer solution ampoule will not crack at low temperatures as was demonstrated in the M256 development program and the limited tests performed during this test program. It remained to be proven, however, that the buffer solution would not hinder performance of the eel enzyme in the nerve agent test. In addition, the quantity of eel enzyme needed to eliminate false positive results but still maintain an increase in the nerve agent detection level had to be determined. This test was conducted in two phases. Phase I was a laboratory evaluation to determine the optimum levels of eel enzyme on fresh and aged enzyme discs. Phase II was conducted to prove that the M256E1 sampler-detector could be manufactured according to the changes established by Phase I and give satisfactory results.

3.6.2 Results of PVT II Phase I.

The enzyme disc must contain at least three units of enzyme to meet the 5-minute color development time when functioned in the absence of agent at 33 °F (Table A-12). In addition, a fresh disc must contain at least four units of enzyme so it will retain the required three units after the accelerated storage period (Table A-13). The sensitivity tests show that discs with four to five units of enzyme will detect VX at levels as low as 0.015 mg/cu m (Table A-14), but 0.005 mg/cu m of VX will not be detected. The buffer solution was used in all tests and did not affect the results.

3.6.3 Results of PVT II Phase II.

The M256E1 sampler-detectors manufactured for this test contained the buffer solution ampoule. The fresh enzyme disc contained 4.1 units of enzyme. The test results are listed in Table A-15. The fresh sampler-detectors correctly responded to 0.02 mg/cu m of VX and 0.005 mg/cu m of GB. The aged sampler-detector correctly responded to the absence of agent when exposed to the interferences that were a problem in PVT I (burning brush, HC smoke, and Sevin). However, the aged sampler-detectors demonstrated a reliability of only 58% after a 5-minute response time at 33 °F, but did meet the 92.5% reliability after an 11-minute response time. The reason for the poor results was that the aged enzyme disc contained only 1.9 units of enzyme (this was due to enzyme degradation of 53%). Since the Phase I test items demonstrated an enzyme degradation of 30% after accelerated storage, the manufacturing methods used for production of the M256E1 sampler-detectors need to be evaluated in order to reduce enzyme degradation.

3.7 PIP Verification Test III (PVT III).

3.7.1 Discussion.

PIP Verification Test III was conducted to solve any manufacturing problems. Since the eel enzyme is very sensitive to moisture, exposure to low quantities of moisture during manufacture or storage will accelerate the degradation rate of the enzyme. After evaluating the manufacturing process, two problem areas were found: the sampler-detector may be exposed to the atmosphere for up to 4 hours after the enzyme disc is added, and the desiccant strip is dried at 176 °F (80 °C) before being assembled in the sampler-detector. To determine the effect of controlling these two variables, additional sampler-detectors were manufactured for testing. The two problem areas were controlled by sealing the sampler-detector in the protective bag within 30 minutes after the enzyme disc added, and heating the desiccant strip to a minimum of 100 °C before assembling it into the sampler-detector.

3.7.2 Results of PVT III.

The test results are shown in Table A-16. The degradation of the eel enzyme was only 44%. This demonstrates an improvement of 9% over the degradation rate of 53% obtained in PVT II, Phase II. As a result, the reliability of the aged sampler-detectors increased to 78% (90% confidence levels) during the blank response test at 33 °F within 5 minutes and 90% reliability within 6 minutes. The sensitivity of the sampler-detector to 0.02 mg/cu m of VX and 0.005 mg/cu m of GB was also verified. This concluded the tests of the M256E1 Chemical Agent Detector Kit since all requirements had been demonstrated to the satisfaction of the user/developer community.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Design and Operation.

The nerve agent test spot has a shelf life of at least 5 years. This can be simulated in an accelerated aging test by heating the sampler-detector to 194 °F (90 °C) for 24 hours.

The M256E1 will detect 0.005 mg/cu m of GB and 0.02 mg/cu m of VX when the eel enzyme disc contains up to 5.5 units of enzyme.

The M256E1 will give the correct response when operated in the presence of field interferences and under all the climatic conditions listed in the Materiel Need for the M256 kit when the eel enzyme disc contains no less than 2.6 units of enzyme. At temperatures of 50 °F or above, a response time of 3 minutes is required. At temperatures of 33 °F to 50 °F, a response time of 6 minutes is required. At temperatures of 32 °F and below, the sampler-detectors are warmed after exposure to the atmosphere and the 3-minute response time is satisfactory.

4.2 Processing.

Conditions must be controlled to minimize exposure of the nerve spot to the atmosphere during manufacture of the M256E1 kit. It is recommended that the enzyme disc be exposed to the atmosphere for no more than 30 minutes before being packaged. In addition, the desiccant strips should be dried at 212 °F (100 °C) or above prior to assembly in the sampler-detector. These two critical conditions should be included in the Technical Data Package for the M256E1 kit.

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APPENDIX

TABLES

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Table A-1. Nerve Agent Detection Systems for the M256 and M256E1 Sampler Detectors

M256 Sampler Detector	M256E1 Sampler Detector
Substrate Solution Ampoule: 0.3 ml of solution containing 0.09% 2.6 dichloroindophenyl acetate and 99.91% ligroin	Substrate Solution Ampoule: 0.3 ml of 70.7% indoxyl acetate, 6% tetrahydrofuran and 93.3% ligroin
Buffer Solution Ampoule: 0.5 ml of a solution containing 0.6% tris (hydroxymethyl) aminomethane, 28.5% HCl (1N) 0.03% dioctyl sodium sulfosuccinate (aerosol OT) and 70.87% water	Buffer Solution Ampoule: Same as M256 buffer solution
Nerve Spot: 0.05 ml of a solution containing 2.5 to 5.5 units of horse serum cholinesterase, 91% gelatin and 8.9% water, impregnated on a 0.5-inch disc of filter paper (Whatman 40)	Nerve Spot: 0.05 ml of a solution containing 2.6 to 5.5 units of eel acetylcholinesterase, 16% POPSO buffer, 0.4% bovine serum albumin, 0.01% Triton X-100 and 83.5% water, impregnated on a 0.5-inch disc of ion exchange cellulose grade paper (Whatman DE81)

Table A-2. Simulated Environments for Sensitivity Tests

Climatic type	Operating conditions
Variable high humidity	27 °C (80 °F) 80 to 85% RH*
Basic hot	43 °C (110 °F) 20 to 30% RH
Basic cold	-25 °C (-33 °F) 30 to 32% RH
Aqueous limit	1 to 3 °C (33 to 38 °F) 80 to 82% RH
Temperate (room ambient)	24 to 27 °C (75 to 80 °F) 22 to 26% RH

* RH - relative humidity

Table A-3. Cyclic Storage Test

Climate type	Storage conditions	Storage schedule	Storage time
Basic cold (C1)	-30 °F (-34.4 °C), RH not controlled	Weeks 1,3,5,7,9	5 weeks
Basic hot (A2)	145 °F (62.8 °C), 44% RH	Weeks 2,4,6,8	4 weeks

Table A-4. Interference Tests

Test substance	Test procedure
Burning brush	Test in the path of smoke
Exhaust fumes (test simultaneously)	Test downwind of the exhaust of two vehicles (one gasoline and one diesel) parked with their engines running
Decontaminants (test simultaneously)	Test downwind of shallow pans containing DANC solution, supertropical bleach, and DS2 solution
Fuel vapors (test simultaneously)	Test above open containers of diesel fuel, gasoline, kerosene, motor oil, and anti-freeze
HC Smoke	Test downwind of one HC smoke grenade.
Colored smoke (test simultaneously)	Test downwind of four smoke grenades (one of each color)
Pesticide (Sevin)	Test downwind of an area that has recently been treated with Sevin

Table A-5. Accept/Reject Criteria for Test Program

Sample size	Number of failures	
	Accept	Reject
33	0	2
64	1	3
98	2	3

Table A-6. PVT I Eel Enzyme Disc Assay Results

Sampler-detector configuration	Fresh discs (units/disc)	Aged discs (units/disc)	
		35 minutes*	24 hours*
Bendix/Worthington	1.3	-	0.9
Bendix/Sigma	1.3	-	0.8
CCC/Worthington	1.8	1.6	-
CCC/Sigma	1.1	1.0	-

*Storage time at 90 °C

Table A-7. PVT I Agent Sensitivity Test Results - GB^a

Sampler-detector type	Variable high humidity	Climate type Basic hot	Climate type Basic cold	Aqueous limit	Temperature (81 °F)
Bendix/Worthington	33/33 ^b	33/33	33/33	33/33	33/33
Bendix/Sigma	33/33	33/33	33/33	33/33	33/33
CCC/Worthington	63/64	33/33	33/33	33/33	33/33
CCC/Sigma	33/32	33/33	33/33	33/33	33/33

^aConcentration levels varied from 0.0025 to 0.006 mg/cu m

^bNo. of successful tests/total tests

Table A-8. PVT I Agent Sensitivity Test Results - V_{1.1}^a

Sampler-detector type	Variable high humidity	Climate type Basic hot	Climate type Basic cold	Aqueous limit	Temperature (81 °F)
Bendix/Worthington	33/33 ^b	33/33	33/33	33/33	33/33
Bendix/Sigma	63/64	33/33	33/33	33/33	33/33
CCC/Worthington	33/33	33/33	33/33	33/33	33/33
CCC/Sigma	33/33	96/98	33/33	33/33	33/33

^aConcentration level varied from .0035 to .006 mg/cu m

^bNo. of successful test/total tests

Table A-9. PVI I Blank Response Test Results

Sampler-detector type	Variable high humidity	Climate type Basic hot	Basic cold	Aqueous limit	Temperature (81 °F)
Bendix/Worthington	50/50 ^a	50/50	50/50	0/25 ^c	25/25 ^d
Bendix/Sigma	50/50	48/49 ^b	50/50	0/25	25/25
CCC/Worthington	50/50	50/50	50/50	0/25	25/25
CCC/Sigma	50/50	50/50	50/50	0/25	25/25

^aNo. of successful tests/total test^bOne considered no test^cExposed and operated at 33 °F^dExposed at 33 °F and warmed to 50 °F for color development

Table A-10. PVT I Cyclic Storage Test Results

Sampler-detector type	+ 33 °F	Operating temperature + 70 °F
Bendix/Worthington	0/21 ^a (4) ^b	23/23 (2)
Bendix/Sigma	0/22 (3)	22/23 (2)
CCC/Worthington	0/16 (9)	19/19 (6)
CCC/Sigma	0/18 (7)	3/23 (2)

^aNo. of successful tests/total tests^bNumbers in parentheses denote number of sampler-detectors found to have broken wetting solution ampoules. These were not functioned.

Table A-11. PVT I Interference Test Results

Sampler-detector type	Burning brush	Exhaust fumes	Decontaminants	Fuel vapors	HC smoke	Colored smoke	Pesticide (Sevin)
Bendix/Worthington	31/50*	50/50	50/50	49/49	44/50	41/50	21/49
Bendix/Sigma	36/50	43/43	50/50	50/50	48/50	46/46	27/50
CCC/Worthington	49/49	50/50	49/49	49/50	43/43	49/49	49/50
CCC/Sigma	44/44	50/50	49/50	49/50	47/50	47/47	43/50

*No. of successful tests/total tests

Table A-12. PVT II Phase I Blank Response Test Results (33 °F)

Enzyme concentration ^a units/disc	No. of successful tests ^b /total tests
2.4	0/50
3.1	50/50
3.6	50/50

^aAged enzyme disc^bFive-minute response time

Table A-13. PVT II Phase I Enzyme Assay Results

Enzyme concentration (fresh disc) units/disc	Enzyme concentration (aged disc)* units/disc
3.2	2.4
4.2	3.1
5.1	3.6

*Aged for 24 hours at 90 °C

Table A-14. PVT II Phase I Agent Sensitivity Test Results - VX

Enzyme concentration units/disc	Agent concentration (mg/cu m) 0.008 0.01 0.013 0.015
3.2	1/8 ^b - 38/39 -
4.2	- 25/30 - 50/50
5.1	- 33/40 - 50/50

aFresh disc enzyme

bNo. of successful tests/no. of tests

Table A-15. PVT II Phase II Test Results

Test	Result
Eel enzyme disc assay	Enzyme concentration (units/disc)
Fresh disc	Average 4.1 (low 3.0, high 5.4)
Aged disc ^a	Average 1.9 (low 1.0, high 2.7)
Blank Response at 33 °F (aged disc)*	No. of successful tests/no. of tests
5-min response time	34/50
7-min reponse time	39/50
11-min reponse time	50/50
Interference tests (aged discs)*	No. of successful tests/no. of tests
Burning brush	48/48
HC smoke	64/65
Pesticide (Sevin)	50/50
Agent sensitivity tests (fresh discs)	No. of successful tests/no. of tests
VX concentration 0.02 mg/cu m	33/33
GB concentration 0.005 mg/cu m	33/33

*Sampler-detector aged for 24 hours at 90 °C prior to testing

Table A-16. PVT III Test Results

Test	Result
Eel enzyme disc assay	Enzyme concentration (units/disc)
Fresh disc	Average 5.1 (low 4.5, high 5.5)
Aged disc	Average 2.8 (low 2.6, high 3.2)
Blank response at 33 °F (aged disc)*	No. of successful tests/no. of tests
5-min response time	44/50
6-min response time	48/50
Agent sensitivity test (fresh disc)	No. of successful tests/no. of tests
VX concentration 0.02 mg/cu m	33/33
GB concentration 0.005 mg/cu m	6/6

*Sampler-detector aged for 24 hours at 90 °C prior to testing

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JC
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